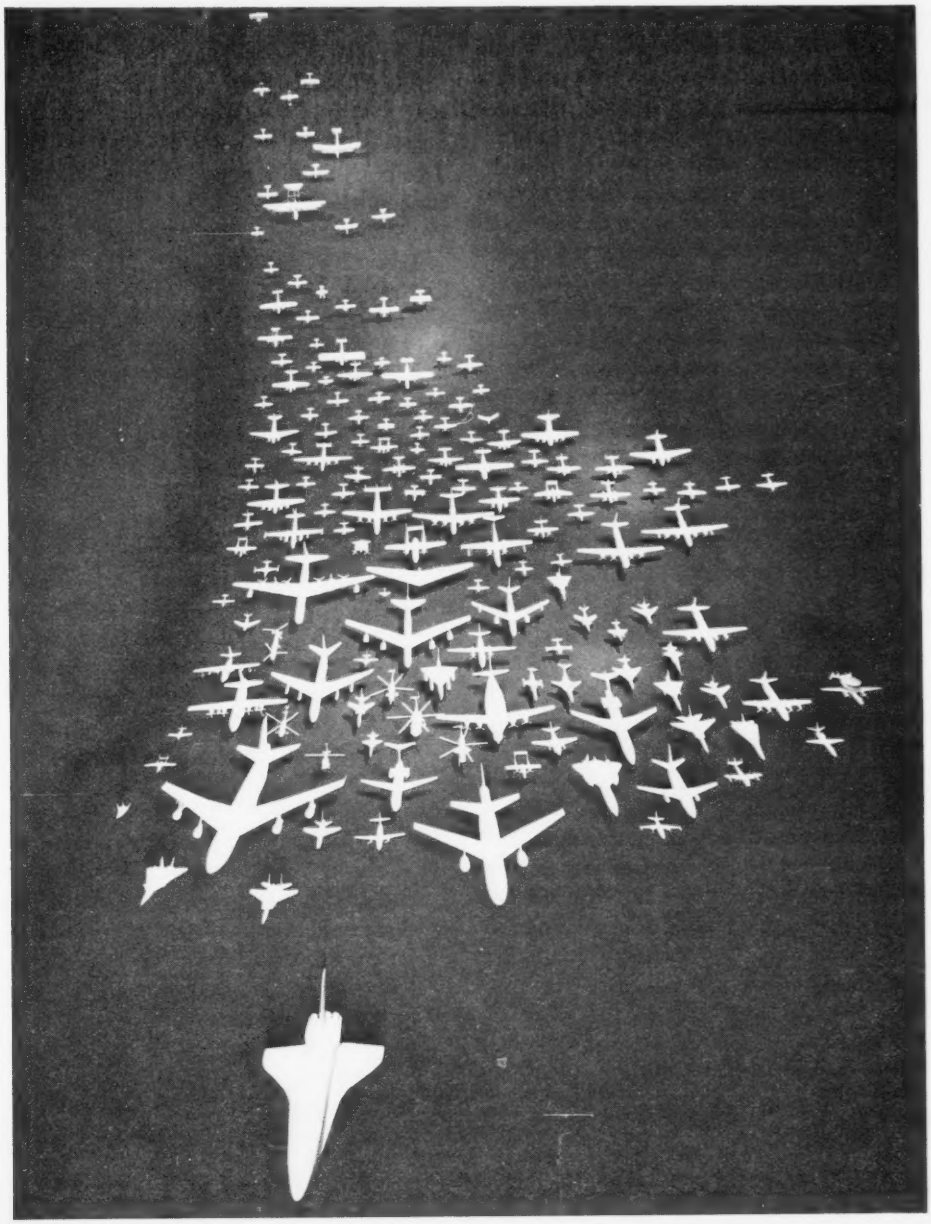
# NASA Activities

National
Aeronautics and
Space
Administration

**April 1978**
**Vol. 9, No. 4**



## Cover

**Aircraft Pageant**—This group of model airplanes exemplifies every type of American aircraft ever flown, from the first flown by Orville and Wilbur Wright (top) to NASA's Space Shuttle, scheduled for launch in 1980. The display appears on a wall of the visitor information center at the Lewis Research Center.

## Table of Contents


| | |
|---|---|
| Letter from Washington | 3 |
| New Landsat Launched | 4 |
| Skylab Update | 6 |
| NASA Satellite Tracking North Pole Explorer | 6 |
| Satellite Teaching Tried at North Carolina University | 8 |
| Experiments Chosen for Shuttle Facility | 8 |
| NASA People Are Honored by Aeronautics Institute | 9 |
| Fleet Satellite Communication Spacecraft | 10 |
| Pivot-Wing Aircraft Will Be Tested | 11 |
| New Officer for OAST | 12 |
| Space Processing Hardware under Development | 12 |
| First Landsat Is Retired | 12 |
| Former NASA Chief Awarded Medal | 13 |
| NASA Testing Winglet Airfoils | 13 |
| NASA's Splendid Failure Revisited | 14 |
| Two NASA Employees Win Top Honors | 18 |
| Lushina Named to New Job | 18 |
| Porpoise's Movements and Habits May Be Tracked by Satellite | 18 |
| Contractor News | 19 |
| Viking Scientists Award Student Grant | 20 |
| NASA European Representative Named | 20 |
| Patents for Inventions | 21 |
| New NASA Publications | 21 |
| Launches for 1978 | 23 |
| Service for Stamp Collectors | 25 |
| Space Shuttle Contributions Recognized | 26 |
| Another Dividend from Air and Space | 28 |



NASA Activities is published monthly by the National Aeronautics and Space Administration for the information of the Agency's employees.

Contributions and recommendations are solicited from headquarters and field centers, and should be addressed to the Office of Public Affairs, Code LFD-10, Washington, D.C. 20546.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Annual subscription rate: $11.55 domestic; $14.45 foreign. Price per single copy: $1.00 domestic, $1.25 foreign. Back issues not available.



Ann Weeks
Editor, Code LFD-10
NASA Headquarters, FOB 6
Washington, D.C. 20546
(Phone: 202 755-8348)

# Letter from Washington

Dear Colleagues:

As we enter our third decade of activity in space in this spring of 1978, I want to emphasize the programs which seek raw, new knowledge or answers to crucial scientific questions as well as the highly visible programs with identifiable, near-term results or benefits. We all readily understand and appreciate the significance of faster, safer, more economical, more efficient airliners; footprints on the Moon; political and sports events on other continents "live via satellite"; television views of global weather from 22,300 miles above the Earth; and Landsat pictures of crops stricken by drought. It is harder, however, to understand the importance of a space telescope able to see back to the beginning of time; an automated mission to orbit and observe the polar areas of the Sun; an orbiting observatory scanning the skies for sources of X-ray and gamma ray emissions; an instrument in geosynchronous orbit to study the ultraviolet light emissions of the stars; or million-channel radio receivers on earth searching the universe for evidence of other intelligent life.

We must understand and communicate that these two seemingly disparate classes of operations are, in fact, closely related and overlapping. They closely relate and overlap because intellectual accomplishment —the acquisition of new knowledge—in addition to being important in itself has always led to usefulness to a degree unimaginable at the time of acquisition. Intellectual importance eventually translates into long-term usefulness—usefulness to human life.

No one can accurately predict the results of the new knowledge which is beginning to flood back to Earth from space. We can look back and recall that the probing intellects of two brothers in a Dayton bicycle shop brought us, in a single human lifetime, global travel times measured in hours instead of days, and that this tied the nations and people of the world together to a degree unimaginable on the dunes of Kitty Hawk in 1903. We can also recall that the rocket experiments of an obscure physics professor in a Massachusetts pasture put Americans on the Moon and American instruments on Mars in only 50 years. Curiosity about the inner workings of solids and curious electronic effects in them have given us the solar cell and the integrated electronics revolution in computing capability and communications. Curiosity about the molecular states of gases led to the laser.

Recalling these things, it is not difficult to imagine that observations from space in the bands of visible light, ultraviolet, infrared, X-rays and gamma rays soon may begin to give us our first hints of the nature of quasars with hundreds of billions of times the energy of the Sun.

We can already see that scientific observations of the Sun from near-Earth and near-Sun space are beginning to give us an understanding of the ways in which the interaction of solar phenomena with the Earth's high atmosphere affects our planet's climate.

As we learn more about the universe, it becomes evident that processes similar to those which seem to be connected to the evolution of life on Earth occurred in other places, too. Thus the probability of the existence of other intelligent beings in a universe of some hundred billions of galaxies, each with billions of stars, appears high. Contact with such beings would be a most significant event in history and in the evolution of our species. Continued failure to find others also would be of significance.

Even a conservative assessment of the collective potential of the new knowledge just beginning to become available shows us the possibility of managing the ecology, atmosphere, and resources of our beautiful but fragile planet in the best interest of all the life which has evolved upon it. If we can accomplish this, it will allow life to develop freely and fully as an integral part of the universe that we are just beginning to understand.

The photographs of Martian rocks, the weather maps from space, the reusable Shuttle, the instruments in space observing all the frequencies of the electromagnetic spectrum, the search for other intelligent life and the footprints on the Moon are all steps in that direction, and all potentially of great value.

If we can truly and effectively impart this message to our fellow citizens, we may have taken the most important step of all.

Sincerely,

Robert A. Frosch

## New Landsat Launched

NASA launched a new, improved satellite to monitor the Earth's resources from the Western Test Range near Lompoc, Calif., on March 5. Landsat 3 is the third in a series of satellites designed to orbit the Earth at an altitude of 917 kilometers and scan our planet's surface in a systematic study of its resources and environment.

The 900-kg Landsat 3 was placed into a 917-km circular, near-polar orbit. Circling the globe every 103 minutes, the spacecraft's remote sensors will view a 185-km wide strip of the Earth running nearly north-to-south at an angle to the equator of 99 degrees.

In that type of orbit, surface coverage of the Earth will proceed westward with a slight overlap, such that the globe will be covered once every 18 days. The spacecraft's orbit is synchronous with the Sun. Thus Landsat 3 (like Landsat 2) will cross the equator at the same time (9:30 a.m. local time) every orbit. This means that the spacecraft's imaging systems are always photographing the Earth under the best possible lighting conditions. Synoptic, repetitive coverage of Earth's surface under consistent observation conditions is required for maximum utility of the multispectral imagery being collected by Landsat 3.

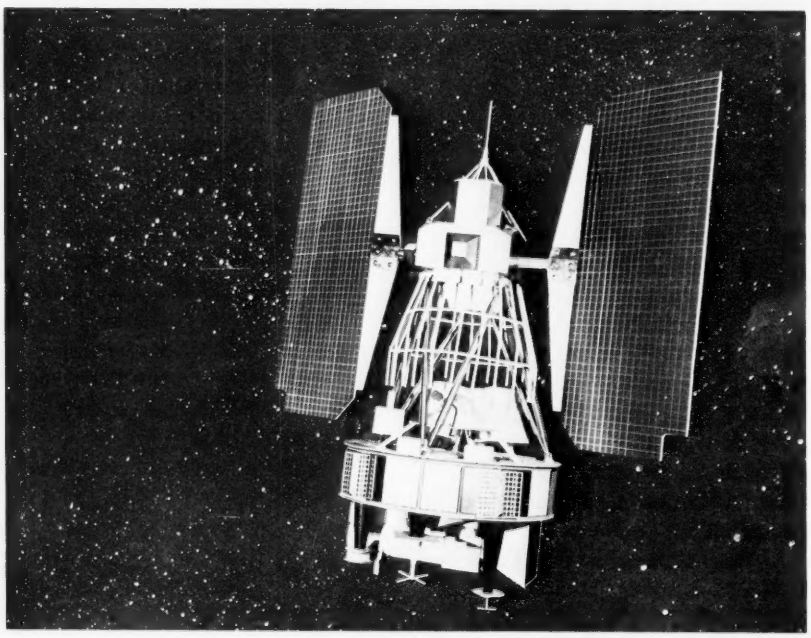
The most common value attributed to the Landsat system is its large-scale perspective. Structural elements, perhaps irregular or even discontinuous within the confines of a smaller area, may be revealed as regional or even semi-continental in extent.

Another major asset of the Landsat system is its repetitive observation which makes possible the detection of short-period changes—as frequently as every nine days when the two satellites are used.

The three most important potential uses of the Landsat data identified so far—energy supplies, food production and global large-scale environmental monitoring—correspond to three of the major problems confronting the world today. Innovations in the Landsat 3 multispectral scanner system (MSS) will provide for the detection, day or night, of temperature differences in vegetation, bodies of water and urban areas. Improvements in the return beam vidicon sensor will increase the resolution of its recorded images by 50 percent. Thus, areas as small as half an acre—about two urban house lots—can be identified and studied.

In addition to its two major remote sensing systems, the Landsat 3 carries a data collection system (DCS). This versatile experiment collects radioed data directly from as many as 1,000 remote ground platforms and relays them to a Landsat data acquisition station. Volcano activity, stream flow, water and snow depth, water temperature and sediment density are some of the measurements the DCS collects.

The satellite was launched aboard a two-stage Delta launch vehicle. In addition to Landsat 3, riding



piggyback aboard the rocket is an amateur radio communications satellite — the Oscar-D. This satellite will be used by amateur radio buffs around the globe for a variety of purposes with particular application to small fixed and mobile stations. Primary emphasis will be placed on its application as a teaching aid in secondary schools.

Another experiment attached to the second stage of the expendable Delta rocket will be a unit to help designers of future space systems. This unit, called the plasma interaction experiment, will remain in orbit at an altitude lower than either the Landsat 3 or the Oscar-D. It is designed to provide information on how to control detrimental interactions between high voltage systems and the electrically charged plasma fields in space.

The improved sensors on Landsat 3 are expected to supply even better data than those collected by Landsats 1 and 2. In agriculture, for instance, an added thermal infrared channel is expected to be the major improvement. The thermal data should provide information on plant stress, vigor and other changes characterized by temperature differences. The improved resolution return beam vidicom system should provide more accurate measurements of agricultural fields to improve crop yield projections.

NASA's research program is being geared to assess the value of these improved data sources as well as to incorporate their information content in the current operational applications of Landsat data by other federal, state and industrial users. The improved Landsat 3 data will provide more accurate discrimination between suburban areas and surrounding rural or farm lands (important for census studies); will increase our ability to recognize "heat islands" associated with urban and industrial developments; and will permit improved monitoring of thermal sources such as mine fires and power plant effluents.

Three NASA tracking and data acquisition facilities are equipped to receive sensor data from the Landsat spacecraft. The Landsat facilities at Goldstone, Calif., and at Goddard Space Flight Center, can receive sensor and DCS data directly from the spacecraft whenever it is in direct line-of-sight. The primary station at Fairbanks, Alaska, collects such data by commanding the satellite's tape recorders to replay during each orbit over the North Pole area.

International interest in Earth resources remote sensing is widespread and growing. Foreign-funded ground stations are now operating in Brazil, Italy and Canada (two facilities). Another station is under construction in Iran and others are being planned by Argentina, Chile, India and Zaire. Australia, Japan and Sweden are among other countries presently considering such an investment.

Landsat ground stations cost the host country some $4 to $7 million to establish and from $1 to $2 million per year to operate. In addition, countries operating these stations are paying the U.S. $200,000 per station a year as of July 1976. This charge was established by NASA to assist in defraying the cost for the space segment. Data from foreign stations is distributed directly by the organizations operating the stations.

Once Landsat data received in the U.S. is processed at the Goddard center, copies will be forwarded to the Department of Interior's Earth Resources Observation Systems (EROS) Data Center at Sioux Falls, S.D. On receipt at Sioux Falls, data are in the public domain and copies can be purchased by anyone.

The overall Landsat program is the responsibility of NASA's Office of Space and Terrestrial Applications, Washington, D.C. Project management for the Landsat spacecraft, the Delta launch vehicle, the NASA image processing facility and the worldwide tracking network rests with the Goddard center. Launching of the Delta is supervised by the Kennedy Space Center's unmanned launch operations team.

General Electric Co., Space Division, Valley Forge, Pa., is the prime contractor for the Landsat spacecraft, the data collection system and wideband video tape recorders aboard the spacecraft and the ground data handling system are at Goddard.

Hughes Aircraft Co., Space and Communications Group, El Segundo, Calif., is prime contractor for the multispectral scanner; and RCA, Astro-Electronics of Princeton, NJ., is prime contractor for the return beam vidicon camera. The McDonnell Douglas Astronautics Co. of Huntington Beach, Calif., is prime contractor for the Delta launch vehicle.

NASA costs for the Landsat program are about $251 million, a sum that includes $149 million for three spacecraft and their instruments, $54 million for the data handling facility at the Goddard center and ground operations, $34 million for support of investigations and about $14 million for three launch vehicles.

## Skylab Update

If NASA decides to reboost the orbiting Skylab space station to a higher altitude—a possibility on the basis of recent findings by NASA crews who were able to recharge Skylab batteries and receive data from its computers—the move could provide an opportunity to reactivate and use the on-board systems and instruments in a variety of useful projects.

The large living quarters and crew accommodations aboard Skylab would be a welcome addition to Space Shuttle and Spacelab missions involving extensive mission equipment and long mission durations. In addition, useful experiments might be conducted with Skylab instruments, some of them in conjunction with complementary instruments planned for flight aboard Spacelab.

Another possibility concerns new experiments, missions and demonstrations made possible with the orbiter that might be feasible if Spacelab were docked with Skylab. Assembly and support of large space structures for communications, solar energy or other public service operations might be accomplished by this means, for instance.

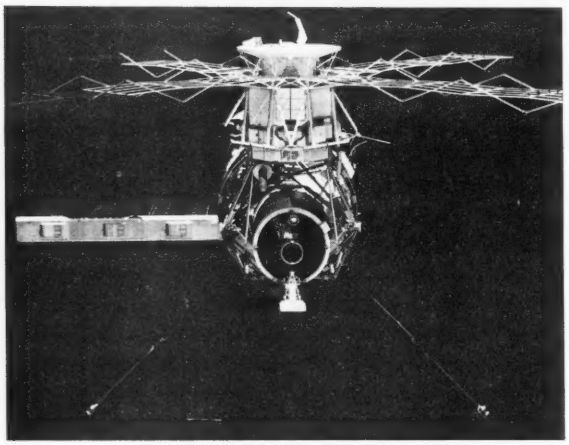
NASA's Marshall Space Flight Center has awarded parallel study contracts, each in the amount of $125,000, to Martin Marietta Corp. at Denver, Colo., and McDonnell Douglas Astronautics Co. at Huntington Beach, Calif. The two firms will conduct simultaneous but independent studies of the possibilities and benefits to be realized from reuse of Skylab.

The spacecraft is the largest payload in Earth orbit. It weighs 86 metric tons and is about 29 meters long. The main portion is cylindrical, 9 m in diameter. In orbit, Skylab is passing above the areas of Earth between 50 degrees north and 50 degrees south latitude.

Skylab was launched in May 1973 and manned during three missions by three different astronaut crews. The last crew left Skylab Feb. 8, 1974 at an altitude of 440 km. Skylab now is 408 km above Earth.

At the time the final crew departed, NASA estimated that the orbiting workshop would remain in space until 1983. Since then, the orbit has decreased and NASA has been adjusting its predictions. Contributing to the more rapid rate-of-descent is an increase in atmospheric drag which in turn is caused by Sunspot activity.

When it became evident, last February, that Skylab could begin reentry into the Earth's atmosphere as early as late summer of 1979 and as late as the second quarter of 1980, NASA project managers began attempts to reactivate the spacecraft. Engineers from the Marshall center, controllers from the Johnson center and tracking crews from the Goddard center spent a week at a ground station in Bermuda, checking out systems that have been dormant aboard the spacecraft for the past four years. The purpose of their activities was to check out the capability of Skylab to respond to commands as a prelude to activating the thruster attitude control system. The results were most encouraging, and plans are presently underway to reactivate Skylab once again this month when the system may be used to reduce atmospheric drag and prolong the Skylab's orbital lifetime, perhaps for several months.

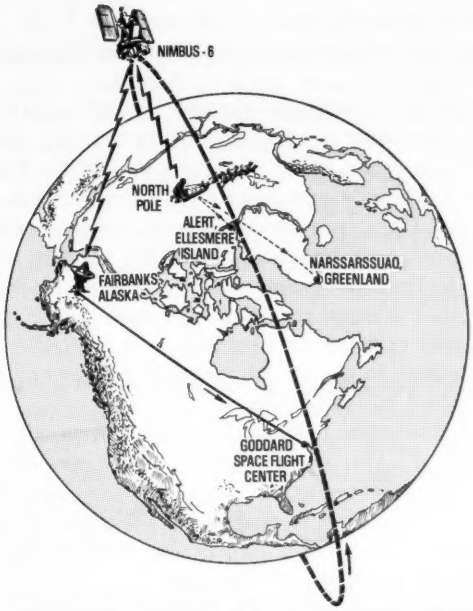


**Eerie View of Skylab**—Skylab looked like this four years ago in its final fly-around, made by astronauts Jerry Carr, Ed Gibson and Bill Pogue just before they returned home. At the time (February 1974) Skylab's orbital lifetime was calculated at 10 years. Atmospheric drag caused orbital decay from its original 237 nautical miles down to 220 in 1978. Photo was taken from the Skylab-4 command and service modules.

## NASA Satellite Tracking North Pole Explorer

A NASA meteorological research satellite, Nimbus-6, will track the 6,000-kilometer trip of a lone Japanese explorer journeying by dog sled to and from the North Pole through northern Canada, traveling the length of Greenland's isolated interior. The six-month-long journey began March 4, 1978. NASA's Goddard Space Flight Center undertook the tracking task at the request of the Smithsonian Institution, which has a scientific stake in the venture.

The explorer is 37-year-old Naomi Uemura of Tokyo whose Arctic experience includes driving a dog sled solo some 12,000 km from Greenland to Alaska in 1975 and 1976 in 18 months. Before that trip, he had lived for a year in a Greenland Eskimo community learning dog-handling techniques and survival tactics.




**Long Journey by Dogsled**—This drawing shows how the Nimbus-6 satellite will communicate with Naomi Uemura as he travels over 6,000 kilometers of hostile Arctic wilderness.

Uemura also is an accomplished mountain climber, having conquered the highest peaks on five continents. He scaled them all by himself except for Mt. Everest, which he climbed as part of a team escort. He has also sailed alone on a raft 6,000 km down the Amazon River.

During his present Arctic journey, Uemura is carrying a 4.5-kilogram satellite beacon package on his dog sled. The battery-powered unit transmits a radio signal automatically once a minute. Included in the signal are the local temperature and atmospheric pressure. The radioed signals are monitored by Nimbus-6, which overflies the poles once every 108 minutes at an altitude of 965 km. Data colected by the satellite are relayed by a NASA tracking station in Fairbanks, Alaska, to the Goddard center. There the position of the dog sled is computed automatically. All data is available to the Smithsonian at least once every 12 hours.

Uemura will take systematic samples of snow, ice and air for Japan's National Institute of Polar Research and the Water Research Institute of the Nagoya University, Japan. He also will record any available evidence of past habitation in northern Greenland.

"We are particularly anxious to have as accurate a record as possible of Uemura's daily positions for correlation with the collected data," said Dr. Lee Houchins, the Smithsonian's principal investigator from the Museum of History and Technology. He added that: "The satellite tracking data will be of further value to us in evaluating Uemura's dead reckoning and celestial navigation techniques, a particularly difficult task in the polar regions"

Uemura departed for the North Pole from a camp near Alert on Cape Columbia, Ellesmere Island, in Canada's remote Northwest Territories. He is following Admiral Peary's 1909 route. If his timetable is accurate, Uemura will reach the Pole some time this month after journeying 800 km. From the North Pole, the Japanese explorer will strike out for the northern tip of Greenland, with hopes of arriving there by June 1. This portion of the journey will equal the first leg in distance.

Using mountain-climbing techniques, Uemura will work his way to the top of the Greenland ice plateau which towers some 3,000 meters above sea level. He will then traverse the 2,700-km length of Greenland, at times using ice sailing techniques to relieve the sled dogs of some of their burden. He expects to arrive at Narssarssauq on the southern tip of Greenland by the end of August.

The straight line distance of Uemura's planned journey is 4,300 km. His actual distance is expected to be more like 6,000 km because of the many lateral trips around ice pressure ridges and stretches of open water encountered during the trek.

NASA's role in the expedition is to provide tracking and data relay services to the Smithsonian. As a special feature, however, the beacon unit on Uemura's dog sled is equipped with a special switch as a back-up to his voice communications system to indicate any emergency. Costs of the venture to NASA are minimal. Both the Nimbus-6 and its ground control computer routinely operate on a 24-hour basis. They acquire data from some 130 buoys, icebergs and other platforms deployed around the world for environmental research.

The satellite beacon unit was obtained at no cost to NASA by Uemura's backers—the Mainichi Newspapers and the Bungei Shunju Publishing Co.,

both of Tokyo, Japan. The unit and its batteries were cold-tested at temperatures of minus 50 degrees Celsius.

The batteries used with the satellite beacon are Lithium Thionyl Chloride packs, developed by the Communications Systems Division of GTE Sylvania, Inc., a subsidiary of General Telephone and Electronics Corp., Needham, Mass.

## Satellite Teaching Tried at North Carolina University

A demonstration of curriculum sharing, using television and NASA's Communications Technology Satellite, recently was conducted at the North Carolina A&T State University in Greensboro. The demonstration, planned by NASA's Langley Research center, represented a "first" for the predominantly black college participating in the educational experiment.

Two days of telecasts originated from the university were transmitted to the satellite located 22,500 miles above the Earth, by NASA's portable Earth terminal, a ground-based communications system contained in a trailer. The program signals were relayed from the satellite to Jackson State University, Miss.; Bell-Northern Research Ltd. in Ontario, Canada; Stanford University and Rockwell International in California. Participants in each location were able to see and communicate with each other.

The program was funded by a NASA contract to investigate the feasibility of using satellites in sharing curriculum information, research techniques and results. Included in the demonstration session was a question and answer session with Frederick D. Gregory, a recently selected NASA Space Shuttle astronaut.

Almost seven hours of satellite time was made available by the Ames center, which controls the CTS. The Lewis center is responsible for the portable earth terminal.

## Experiments Chosen for Shuttle Facility

Four scientific experiments tentatively have been selected for NASA's long duration exposure facility, scheduled as a major Space Shuttle payload in 1980. The four join 23 technology experiments chosen for LDEF earlier this year.

The experiments are designed to assess the hazards to man of ion particles in space, the chemistry of micrometeoroids, the interstellar wind and cosmic ray nuclei.

LDEF is an unmanned, reusable, free-flying facility on which many different technical and scientific experiments can be mounted in special trays. The device provides an easy and economical way to conduct primarily passive experiments in Earth orbit. It is managed by NASA's Langley Research Center.

Principal investigators for the scientific experiments represent three European universities, the European Space Agency and NASA's Johnson Space Center. The new experiments were chosen from among 55 proposed experiments related to scientific disciplines, including astrophysics, life sciences, lunar and planetary studies, solar terrestrial studies and upper atmospheric physics. A total of 190 candidate experiments were submitted to NASA in response to an announcement-of-opportunity distributed in June 1976.

Upon selection of the science experiments, 80 percent of LDEF's experiment trays are now filled with individual research projects. The remaining 20 percent will contain micrometeoroid detection panels designed to measure the number and variety of tiny meteoroid particles in Earth orbit.

Nestled inside the Shuttle Orbiter's cargo bay during launch from NASA's Kennedy Space Center, LDEF will be placed in a circular Earth orbit of 435 kilometers (270 miles) with an inclination to the equator of 28.5 degrees. LDEF will remain in orbit from six to nine months while its experiments are exposed to the space environment. At the end of the mission, LDEF will be retrieved by the orbiter and returned to Earth. Experiments will be returned to their investigators for analysis.

Selected expeiments and their principal investigators are:

- **Free Flyer Biostack Experiment**—Investigator: Dr. Horst Bucker, Universität Frankfurt am Main, West Germany.

The experiment will investigate the biological effectiveness of the structured components of cosmic radiation during space flight, emphasizing the effects of individual, very heavy ions. Information will be used to quantitatively assess the hazards of heavy ion particles to man in space, and establish radiation protection guidelines for man and biological experiments in future space flights. A six-month

LDEF mission will yield about 360 percent more comparable data than a typical Apollo mission could have collected.

- **Interstellar Gas Experiment**—Investigators: Dr. Don L. Lind, NASA Johnson Space Center and Dr. Johannes Geiss, University of Bern, Switzerland.

The experiment will analyze the interstellar noble gas (inert gases such as argon, freon, helium, and others) atoms that penetrate the heliosphere to the vicinity of Earth. The structure of the interstellar gas flux varies considerably at different points in Earth's orbit. By collecting particles at several locations, the experiment will detect interstellar gas, and collect data on the dynamics of the interstellar wind as it flows through the heliosphere and interacts with other solar elements.

- **High Resolution Study of Ultra-Heavy Cosmic Ray Nuclei**—Investigators: D.V. Domingo and Dr. K.P. Wenzel, European Space Agency, The Netherlands; Prof. C.O. Ceallaigh, Dr. D. O'Sullivan and Dr. A. Thompson, Dublin Institute for Advanced Studies, Ireland.

The experiment will be devoted to charge and energy spectra of cosmic ray nuclei, and search for super-heavy nuclei and heavy anti-nuclei. Information will help explain the physical processes of ultra-heavy nuclei production and acceleration at the source in interstellar space. Information on nucleosynthesis will also be obtained.

- **Chemistry of Micrometeoroids**—Investigator: Dr. Fred Horz, NASA Johnson Space Center.

The experiment is designed to obtain chemical analysis of a statistically significant number of micrometeoroids, and information about micrometeoroid density, shape and mass flux. If present hypotheses are correct—that most micrometeoroids are derived from comets—their chemical characterization becomes of great significance. Comets are generally considered to be relatively unaltered objects that reflect some arrested condition of early solar system condensation. The solid matter that makes up a comet appears to be a rather primitive substance and thus may offer rare insight into the formation of comets and the early solar system.

## NASA People Are Honored by Aeronautics Institute

Two scientists at the Ames Research Center, the directors of the Langley Research Center and the Marshall Space Flight Center, two former astronauts and a former NASA Administrator were singled out for special recognition at the 14th annual meeting of the American Institute of Aeronautics and Astronautics, held at Washington, D.C. in February.

Kutler

Lomax

They are: Dr. Paul Kutler and Harvard Lomax of the Ames center; Donald P. Hearth of Langley; Dr. William C. Lucas of Marshall; Sen. Harrison H. Schmitt; David R. Scott; and Dr. James C. Fletcher.

Top honors went to Kutler, who received the Lawrence Sperry Award for "furthering the understanding of supersonic aerodynamics through development of numerical methods that solve flow fields with intricate shock and expansion wave interactions." The award, with a medal and certificate, is made annually for notable contributions by a young person for the advancement of aeronautics or astronautics.

The others, except for Fletcher, were named AIAA Fellows. He was elected an honorary fellow. AIAA Fellows are persons of distinction in aeronautics or astronautics who have made notable and valuable contributions to the arts. sciences or technology. AIAA is the principal professional organization representing all aerospace disciplines.

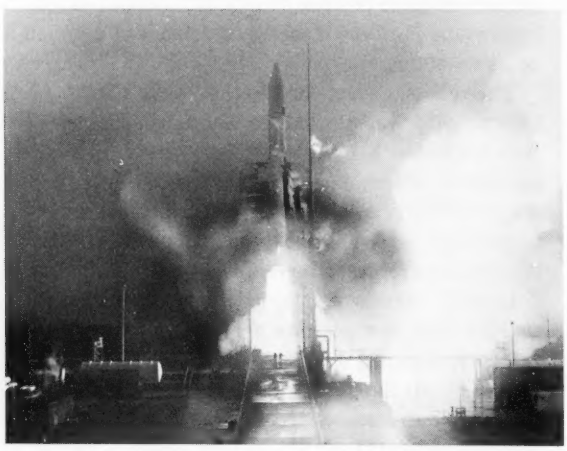
Lomax' citation mentioned "his exceptionally creative work in supersonic aerodynamic theory and computational fluid dynamics." Lucas was selected for the honor "in recognition of your many outstanding contributions and acknowledged leadership in the professional aerospace community." Hearth's citation referred to his "major contributions to NASA's planetary exploration programs and for his direction of the Outlook for Space study."

## Fleet Satellite Communication Spacecraft

The first spacecraft in a new worldwide military communications system was launched from the Cape Canaveral Air Force Station on Feb. 9. The new system, called Fleet Satellite Communication (FLTSATCOM), will support vital communication needs of the U.S. Navy, Air Force, Department of Defense and the Presidential Command Network. FLTSATCOM-A was launched atop Atlas Centaur 44 from pad A of launch complex 36.

The 1,874-kilogram satellite is about 390 kg heavier than any satellite previously launched into synchronous orbit by an Atlas Centaur vehicle. Atlas Centaur is NASA's standard launch vehicle for intermediate weight payloads. It is used for the launch of Earth orbital, Earth synchronous and interplanetary missions. The Atlas Centaur 44/FLTSATCOM configuration, standing approximately 39.9 meters high, consists of an Atlas SLV-3D booster and a Centaur D-1AR second stage.

Atlas Centaur 44 placed the FLTSATCOM-A into a highly elliptical transfer orbit of 167 by 35,813 kilometers. Control of the spacecraft was then transferred to the Air Force Systems Command's Space and Missiles Systems Organization (SAMSO). Air Force satellite controllers fired the spacecraft's onboard apogee kick motor at a chosen apogee to convert the elliptical orbit to a circular one and maneuver the satellite to its station 35,900 km above the equator at 100 degrees west longitude.



**Number One**—FLTSATCOM-1, the first in a new worldwide system of military communications satellites, as it was launched from Cape Canaveral.

Like all full geosynchronous satellites, FLTSATCOM-A will appear to remain stationary in the sky while actually completing one 265,000-km orbit each day. The spacecraft has a design life of five years.

FLTSATCOM is a new and highly versatile military communications system. Each satellite in the series will provide 23 operating channels. The Navy will utilize one fleet-broadcast and nine fleet-relay channels to provide communications between naval aircraft, ships, submarines and ground stations—both ship-to-ship and ship-to-shore. The satellite system will provide reliable, secure communications between naval units anywhere in the world (except the extreme polar regions which are covered by other satellites). Even relatively small vessels can be equipped with the inexpensive antennas and simple equipment needed to participate in satellite communications.

The Air Force share of each FLTSATCOM will be 12 narrow band channels. These will become part of the Air Force Satellite Communications System (AFSATCOM), which will include both FLTSATCOMs and other spacecraft.

AFSATCOM links the national Command Authority with Strategic Air Command (SAC) units, and other arms of the Air Force. The Air Force has ordered 600 terminals for installation in SAC's bomber fleet, airborne command posts, early warning aircraft, and Minuteman and Titan intercontinental ballistic missile control centers.

The Department of Defense reserves one channel for its use. A separate S-band channel is used by the spacecraft controllers.

The FLTSATCOM program is managed by the Naval Electronic Systems Command. Acquisition of the space segment of the system is the responsibility of SAMSO. FLTSATCOM satellites are built by TRW Defense and Space Systems. Atlas Centaur vehicles are built by General Dynamics/Convair. Rockwell International/Rocketdyne builds the Atlas booster engine system. The Centaur engines are manufactured by Pratt & Whitney. NASA's Lewis Research Center has management responsibility for the Atlas Centaur development and operation.

NASA's Kennedy Space Center expendable vehicles directorate assumed vehicle checkout and launch responsibility once the launch vehicle arrived at Cape Canaveral.

The launch cost approximately $85 million—$65 million for the satellite and $20 million for the Atlas Centaur launch vehicle and related services.

NASA is reimbursed for all costs of the Atlas Centaur and launch services by the Department of Defense under provisions of a launch service agreement.

## Pivot-Wing Aircraft Will Be Tested

NASA's Dryden Flight Research Center has awarded a $218,000 fixed-price contract to the Ames Industrial Corp., Bohemia, N.Y., for the development and fabrication of a small, lightweight, manned, oblique-wing aircraft.

Because the pivoting oblique wing concept is a significant departure from conventional aircraft design, NASA is initiating this low-cost exploratory program to study the fundamental aspects of piloting an oblique-wing aircraft.

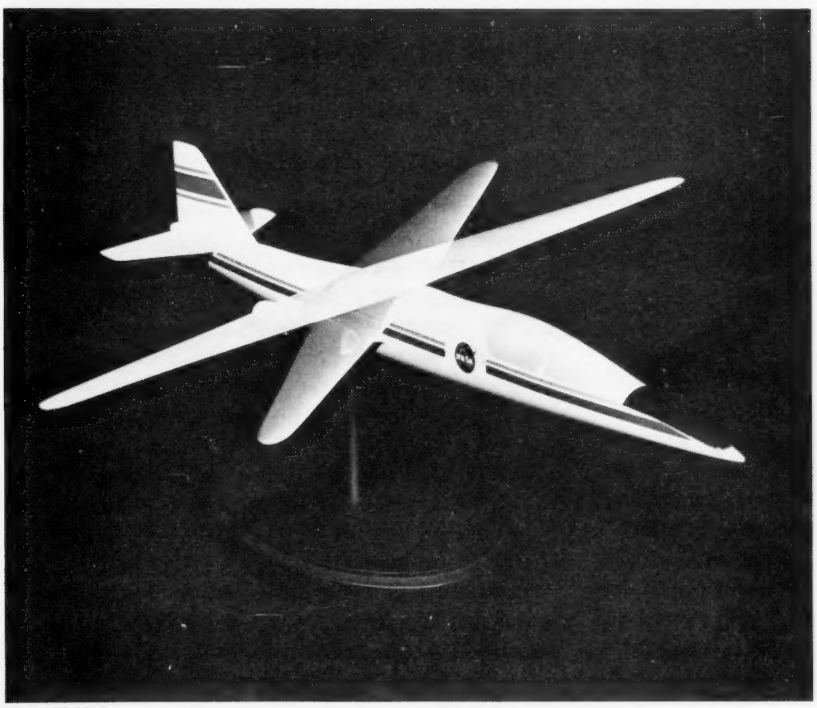
At low flight speeds, the wing is oriented perpendicular to the fuselage, providing efficient, quiet operation for takeoff and landing as well as for low-speed cruise flight. The concept offers good low-speed stability and control characteristics and does not require complex high-lift systems. The engine thrust required for takeoff is substantially reduced, which could result in quieter takeoffs and landings.

For high-speed flights, the wing is pivoted fore and aft to form oblique angles up to 60 degrees with the aircraft's fuselage. Studies indicate that this "scissor-wing" concept would make for better high-speed flight performance. As the aircraft flies faster, pivoting the wing to an oblique angle decreases air drag, thus permitting increased speed and longer range for the same fuel expenditure.

Analytical and wind tunnel studies conducted by NASA's Ames Research Center indicate that a future oblique-wing transport aircraft flying at 1,000 miles per hour might achieve twice the fuel economy of either the current British-French Concorde or the Russian SST. These studies also indicate that the new concept would help alleviate the sonic boom problem.

Under terms of the contract, NASA will provide the contractor with a design and Ames Industrial Corp. will construct the aircraft of foam and fiberglass. Called the AD-1 (NASA Ames-Dryden-1), the aircraft will be approximately 12 meters (40 feet) long with a wingspan of 10 m (32 ft.). Powered by two small 90-kilogram (200-pound) thrust turbojet engines, the AD-1 will have a gross weight of approximately 816 kg (1,800 lb.).

Delivery of the aircraft to the Dryden center is expected in late 1978 and the first flights are planned for early 1979.



**New Wing**—Model of the pivotal wing aircraft to be tested at the Dryden center.

## New Officer for OAST

Dr. John M. Klineberg became Deputy Associate Administrator of the Office of Aeronautics and Space Technology in February. Under the direction of the OAST Associate Administrator, Klineberg is responsible for the general management and direction of OAST programs.

He came to the NASA Ames Research Center from the California Institute of Technology in 1970. While at Ames, he conducted fundamental research in the area of transonic flow, with particular emphasis on viscous effects and boundary-layer separation. In 1974, Klineberg transferred to the OAST aerodynamics and vehicle systems division at NASA headquarters where he managed the NASA aeronautics research programs for short and reduced take-off and landing, vertical take-off and landing and rotorcraft vehicles. In 1976, as a member of the OAST aircraft energy efficiency office, he was responsible for the aerodynamics and active controls elements of the NASA aircraft energy efficiency programs.

A native of New York City, Klineberg graduated from Princeton University in 1960 with a B.S. in engineering and received an M.S. in 1962 from the California Institute of Technology. He was awarded a Ph.D in Aeronautics and Political Science from the California Institute of Technology in 1968. He is a member of AIAA and Sigma Xi. He is the author of a number of technical papers.

## Space Processing Hardware under Development

Development of hardware systems began early this year to support materials processing experiments to be performed aboard the Space Shuttle in mid-1981.

NASA's materials processing in space program (MPS) is designed to take advantage of the near weightlessness aboard the Space Shuttle while in Earth orbit. In that environment, sedimentation in liquid materials is eliminated and movement of fluid caused by heat is reduced, allowing for precise control of processes such as casting and crystal growth.

One example of advances that might be expected as a result of space processing can be illustrated by an experiment performed during the Apollo-Soyuz mission in 1975, in which live kidney cells were separated. The separated cells produced urokinase, an enzyme used to dissolve blood clots, at a much greater rate than could be realized in similar experiments at the Earth's surface.

NASA's Marshall Space Flight Center asked industry to submit proposals by last Feb. 23 for the effort required to support eight materials processing experiments on 1981 Shuttle/Spacelab missions. Items to be developed include a fluids experiments system and a solidification experiments system with a high-temperature furnace.

The fluids experiments system will provide a facility in the Spacelab for conducting fluid phenomena investigations, using optical observation techniques. It will accommodate a variety of experiment cells for performing a broad range of fluid experiments.

The solidification experiments system will provide a multi-use system for conducting MPS experiments with many types of metals, alloys, eutectics, semiconductors, crystals, ceramics, glasses, etc., by melting, refining and resolidification in the near weightlessness of Earth orbit.

A "ground control" laboratory, housing flight-related hardware systems, will be installed at the Marshall center, to allow scientists to process "control samples" under identical conditions, except for the gravity level, as those being performed aboard the Shuttle. The lab also may be used to train payload specialists who will perform the experiments in space.

## First Landsat is Retired

Landsat 1, the world's first spacecraft designed to discover and monitor the Earth's natural resources was retired by NASA last Jan. 16, after operating for more than half a decade in outer space. The multispectral scanner, a camera-like device carried by Landsat 1, has revolutionized the technology of observing the Earth from space.

Designed with a life expectancy of only one year, Landsat 1 was launched in 1972. The spacecraft, said Ron Browning, Landsat project manager at NASA's Goddard Space Flight Center, ". . . more than achieved its goals, in fact, did so beyond any stretch of the imagination."

Browning said problems with the pitch wheel, the device that automatically keeps the satellite and its instruments pointed toward the Earth, have increased during the past two years and that

time-command problems also have developed. Both tape recorders on the satellite have long been inoperative, the first having stopped in August 1972, the second in July 1974. Since then, the satellite has been transmitting its images of Earth directly to ground stations around the globe as they came within the satellite's range. Problems with the pitch wheel brought these operations to a halt.

Landsat 2, launched in 1975, is still in orbit and was joined by a third Landsat in March.

The first Landsat's more than 300,000 pictures of different parts of the world demonstrated the potential of remote sensing from Earth resources spacecraft in fields such as geology, oceanography, agriculture, forestry, hydrology, urban planning, crop prediction and many others.

Such information is important to the United States and the rest of the world. Global analyses of food and mineral resources, for example, are vital to economic planners worldwide. Such data can be updated rapidly and frequently.

Data received by U.S. stations are sent to the Goddard center for pre-processing and distributed to data distribution facilities of the Department of Interior, Department of Agriculture, and Commerce's National Oceanic and Atmospheric Administration.

## Former NASA Chief Awarded Medal

Former NASA Administrator Dr. James C. Fletcher was presented with the NASA Distinguished Service Medal in a ceremony at NASA headquarters early this year. The presentation, made by Dr. Frank Press, President Carter's Science Advisor, was in recognition of Dr. Fletcher's distinguished leadership. The citation noted that "His outstanding scientific and administrative abilities contributed immeasurably to the nation's significant achievements in the exploration of space and the utilization of space to manage the Earth's resources.

"His unceasing advocacy, before the Congress and the public, of a sound, balanced program for areonautics and space won for the United States a preeminent position in both advanced aviation technology and the development and use of space technology to benefit life on Earth.

"His decision to proceed with the development of the Shuttle orbiter exemplified the perceptive leadership which foresaw space as a giant laboratory in which men will work to improve the future of all mankind."

Fletcher, who served as NASA Administrator from April 27, 1971, until May 1, 1977, is now a consulting engineer and vice president of the National Space Institute in Washington, D.C. He holds the Gulf-Whiteford chair in the School of Engineering at the University of Pittsburgh.

A native of Millburn, N.J., he received a B.A. in physics from Columbia University in 1940. After serving as a research physicist with the U.S. Navy Bureau of Ordnance, he became a research associate at Cruft Laboratory, Harvard University, and then in 1942, an instructor at Princeton University.

After receiving his Ph.D. in physics in 1948 at the California Institute of Technology, he worked with Hughes Aircraft Co. and Ramo-Woldridge Corp.'s guided missile research division, which later became Space Technology Laboratories. In 1958, with an associate, he organized and was first president of Space Electronics Corp., Glendale, Calif. After merger with a portion of Aerojet, Dr. Fletcher became President and then chairman of the newly formed Space General Corp. In 1964, he became the eighth president of the University of Utah, a post he held for seven years.

For many years, Dr. Fletcher was associated with the President's Science Advisory Committee and has served on several Presidential task forces.

He is a fellow of the Institute of Electrical and Electronics Engineers, American Institute of Aeronautics and Astronautics, the American Academy of Arts and Sciences, the American Astronautical Society and was elected to the National Academy of Engineering. He was a recipient of the first Distinguished Alumni Award of the California Institute of Technology and holds an honorary doctorate from the University of Utah.

## NASA Testing Winglet Airfoils

NASA's Dryden Flight Research Center has received a U.S. Air Force jet cargo/tanker aircraft, which will be modified and flown to study a new concept that could provide significant fuel savings.

Winglets—2.7-meter (9-foot) long airfoil sections—will be attached to the wingtips of a KC-135 aircraft. The winglets are expected to improve the performance of the aircraft in cruise flight by about eight percent. According to the Air Force flight dynamics laboratory, this performance improvement

could result in annual fuel savings of 11.9 million liters (45 million gallons) for the KC-135 aircraft series, based upon 1975 utilization rates.

Additional NASA studies indicate that the winglet concept also might be beneficial to existing medium-weight civil transport aircraft.

The winglet concept was developed in wind tunnels at NASA's Langley Research Center by Dr. Richard T. Whitcomb, who also designed the supercritical wing.

The winglets are 0.6 m (2 ft.) wide at the tip, 1.8 m (6 ft.) wide at the base, and weigh almost 68 kilograms (150 pounds) each. They will be constructed of aluminum and installed on outer wing panels by the Boeing Co. under an Air Force contract with an estimated value of $3 million. The outer panels with the winglets will be installed on the KC-135 by Dryden center personnel.

Following instrumentation of the KC-135, a series of baseline flights will be flown beginning in late 1978. The winglet should be installed in early 1979 and first flights in the joint NASA-USAF program are scheduled soon after installation is completed. Data from flights with the winglets will be compared with data from baseline flights to determine the effectiveness of the winglets.

## NASA's Splendid Failure Revisited

*Apollo 13, designed to be the third manned Moon landing mission, became an epic struggle as ground-based scientists, engineers, astronauts and technicians worked frantically to find ways to save their friends and colleagues, trapped in a foundering spaceship.*

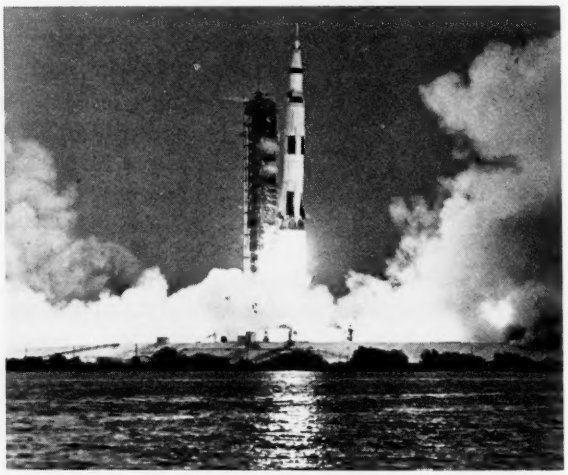
To the hundreds of NASA people involved with the launch of Apollo 13 eight years ago on April 11, 1970, the circumstances and moods that prevailed were not too different from those surrounding the many launches that had gone before—that is, within the context of an organization that was about to hurl into space a small vehicle containing three men who were supposed to be among the first human beings ever to set foot on the Moon.

At the Florida launch site, skies were clear, the causeways and grounds around the Kennedy Space Center were packed with people and cars, and hundreds of representatives of news media worldwide were in place, ready to inform millions of watchers and readers of the progress of this "routine" trip to the Moon. The atmosphere

**Bright Beginning**—Haise, Swigert and Lovell (l. to r.), ready for anything, just before they began a perilous journey into the unknown.

throughout NASA and particularly at the Johnson Space Center's mission control center in Houston was one of tightly controlled excitement, anticipation, and confidence.

There was no premonition, no foreboding that the next six days were to go down as among the most harrowing in NASA's history. The most serious pre-launch "glitch" was that, because long-time Apollo 13 team member Thomas K. Mattingly III was susceptible to German measles, he had to be cancelled out of the mission at the last moment. He was replaced by astronaut John L. Swigert. (The crew had been exposed to the disease the weekend before the scheduled launch; the other members, Jame A. Lovell and Fred W. Haise, Jr., were immune to it.) NASA authorities decided that they could not take a chance that one of the three might fall ill on the crucial journey.

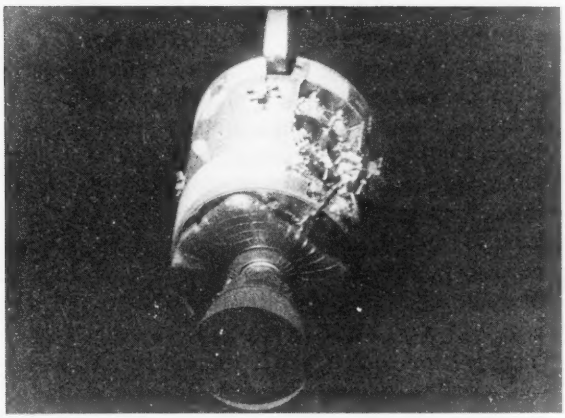


**Fateful Launch of Apollo 13**—This was the day and the beautiful look of it as a perfect launch turned into a life-or-death drama for three astronauts, whose struggles were watched by millions.

**Mission Control Tuned in**—At the Johnson Space Center, all was serene and the Apollo 13 flight looked good as a relaxed Fred Haise reported back by television shortly before the disaster began.

**After the Big Blow-up**—At Houston, the fears and worry caused by the problems of their colleagues in space are etched on the faces of a group of eight astronauts and flight controllers as they monitor console activity in the mission operations control room.

The launch took place without abnormal incident. Apollo 13 achieved Earth orbit at 2:26 p.m. EST. The spacecraft and its still attached Saturn V third stage were thoroughly checked while in orbit. At 3:40 p.m., the astronauts sent their first telecast. A check of all systems after shutdown of the Saturn vehicle that day showed that all operations were satisfactory. Soon afterward, Odyssey (the command module) separated from its adapter connection to Saturn; at the same time, the sides of the adapter fell away, exposing Aquarius (the lunar module designed for landing two men on the Moon, serving as a shelter and base during a short lunar stay, and later returning the astronauts to Odyssey, which would await them in orbit). As things turned out, Aquarius was to become the crew's salvation.



**First View of Severe Damage**—As the LM drew away from the crippled service module, the astronauts got their first look at the shocking ravage caused by the explosion. Picture shows that an entire panel was blown away.

After this operation, the astronauts turned Odyssey around and docked it nose-to-nose with Aquarius, then backed the two craft away from Saturn and headed for the Moon on a course so true that a scheduled course adjustment was cancelled. No further events were scheduled until Sunday, the next day, when the world watched as the spacecraft was accurately rerouted to orbit within 70 miles of the Moon. Activities continued satisfactorily through the next day, Monday, with much joking and easygoing conversation between the spacecraft and the Johnson center command post as Lovell and Haise entered and checked out conditions in the pressurized Aquarius for the first time.

At about 10 p.m. the next day, April 13, while Haise was in Aquarius, Lovell in the tunnel between the two vehicles, and Swigert in Odyssey, the nightmare began when they were startled by a loud bang. They were not unduly alarmed until Haise, who had gone back to the command module, on scanning the instrument panel saw that one of the main electrical systems of Apollo 13 was deteriorating.

A few minutes later, the words that were to haunt a generation of the NASA family came through as Jack Swigert announced in a calm voice to the mission control center: "Houston, we've had a problem." Later, Lovell said ". . . We all rather jumped up and were sort of worried but thought it was his [Haise's] joke . . . But then I looked up at Fred and Fred had that expression like it wasn't his fault. We suddenly realized that something else had occurred . . . but exactly what we didn't know."

At the time of the explosion, Apollo 13 was 205,000 miles from Earth and more than 50,000 miles from the Moon, traveling at 2,100 miles per hour. To all intents and purposes, as would later be revealed, the astronauts were far out in space with a dead mothership (Odyssey), including the main propulsion engine. But let the astronauts and mission control tell it as they saw it, in some of the dialogue that took place after the magnitude of the "problem" began to be realized, and ground emergency procedures had begun.

"Spacecraft: "We've had a Main B bus undervolt . . . we got a Main bus A undervolt . . . Main B is reading zip right now. [Main A and B referred to the command-service module's two main electrical circuits.] And it looks to me, looking out the hatch, that we are venting something. We are venting something out into space. It's a gas of some sort.

"Control Center: We'd like you to power down. Pressure is going slowly to zero and we're starting to think about the lunar module lifeboat. [Pressure in the all-important tanks which fueled the cells representing Apollo's primary power source had dropped to zero in eight seconds.]

"CC: [At 11:24 p.m., 57 hours and 11 minutes after launch.] We figure we've got about 15 minutes worth of power left in the command module. So we want you to start getting over in the LM and getting some power on that. I have an activation procedure—for you to copy down."

Step by step, following instructions from the ground, Haise and Lovell powered up Aquarius, and Swigert battened down the crippled Odyssey. From then on, except for the final phase of the flight, it was used only as a bedroom. The three moved through the connecting tunnel into the lunar module "lifeboat" just before midnight. Unable to see the full extent of the damage until much later—82 hours after it happened—the three astronauts did not fully realize their awful plight. Some NASA observers wondered whether, had they been aware of the extent of the destruction to the service module, their instincts for survival might not have been weakened.

On the ground, the control center—after all kinds of alternatives had been considered—decided that the shortest way home for the endangered men would be to coast on around the Moon and then be pulled automatically back toward Earth. But, and it was a big "but," to reach the Moon, the spacecraft's trajectory had to be changed. A layman might ask: "Why not just turn it around, like a car, and return to Earth?" That would have taken more propulsion than Aquarius had at its command. Any change would have to be done by firing the lunar module's descent engine, an emergency procedure that had been done only in simulations.

At this point, mission control set about mobilizing all the talent it could muster to help solve the myriad problems of getting Apollo on the truest and surest course for home; and conserving the limited power, oxygen and water available to the astronauts. Not only were NASA experts working around the clock, but added to the network were specialists and computers from North American Rockwell, the contractor; Grumman Aerospace Corp., manufacturer of the LM; TRW Systems, builder of the descent propulsion engine; and many others. Their efforts made the difference between life and death for the three astronauts during the following 86 hours and 57 minutes of excruciating suspense and discomfort.

As the men in Apollo 13 experienced what no man had undergone before, the attention of millions of people all over the world was riveted by radio and TV on the plight of the hapless but undaunted trio. The President cancelled appointments and drove out to the Goddard center to receive direct reports; Pope Paul prayed for their safety; prayers were said at Jerusalem's Wailing Wall and on the floor of the Chicago Board of Trade; the U.S. Senate adopted a resolution calling for a prayer pause all over the nation; and offers of assistance poured in from the Soviet Union and many other nations.

The question of how to get the spaceship back on a free-return trajectory that would bring it down in an ocean was resolved by a command post plan to fire Aquarius' engine fast in a short burn, then another burn two hours after the closest approach to the Moon, dropping the service module, and putting the command module into the correct attitude for reentry into Earth's atmosphere. The splashdown was to be in the mid-Pacific.

At 7:21 p.m., Tuesday, Apollo 13 swung behind the Moon, lost contact with Earth, and passed 164 miles over the lunar surface. At 7:49, the spacecraft emerged on the other side and was again picked up by tracking stations. According to plan, moments later the 15-ton third stage of the Saturn vehicle crashed onto the Moon's surface in one of the few successes

realized on the mission. This move was designed to contribute data to a study of Moonquakes.

Now it was time for the second firing of the descent engine, which would add 585 miles per hour to the velocity of the spacecraft and bring it to Earth off American Samoa 10 hours sooner than had been considered earlier. It was accomplished successfully and, except for the extreme cold (38° F) of the two cabins, the outlook by Wednesday morning was reassuring. Plenty of drinking water could be brought over from the command module; oxygen stores showed a margin of 95 hours; cooling water and batteries would last for some hours beyond reentry; and command module battery strength was ample to operate after separation. A variety of jerry-built, do-it-yourself measures, had to be put into use to solve some of the unprecedented problems that cropped up, but no additional major changes in the schedule were foreseen.

Apollo 13 entered Earth's sphere of gravitational influence at 8:38 Wednesday morning, still 216,277 miles from home, but another course correction had to be made near midnight. Again the safety of the three depended on Aquarius' descent engine. That third burn was successful and Apollo went into the proper reentry corridor. For the next 24 hours or so, activity in the cold, tomblike Aquarius was at a minimum as the command module's reentry batteries were recharged from the lunar module. Thursday evening, mission control began hours of reciting check lists to Swigert, then Haise. Shortly before 4 a.m., Friday, powering up of Aquarius began, three hours earlier than planned. A final course correction at 7:53 put the spacecraft exactly in the center of the corridor in which it was to reenter the atmosphere. On command, Aquarius jettisoned the useless service module. Some of the conversation between ground control personnel and the astronauts follows:

"SC: That Earth is whistling in like a freight train . . . And there's one whole side of that spacecraft missing . . . right by the high-gain antenna, the whole panel is blown out, almost from the base to the engine . . . it's really a mess . . . Man, that's unbelievable—looks like a lot of debris is just hanging out of the side near the S-band antenna."

Then, as Haise began shutting down the Aquarius so the men could transfer into Odyssey:

"SC: Well, I can't say that this week hasn't been filled with excitement.

"CC: Well, James, if you can't take any better care of the spacecraft than that, we might not give you another one."

At 11:23, Swigert punched the button that jettisoned Aquarius from Odyssey. The lifeboat would burn up in the atmosphere.

"CC: Farewell, Aquarius, and we thank you.

"SC: She sure was a great ship."

The spacecraft's speed rose dramatically as it angled Earthward to more than 24,000 m.p.h. just before the plunge into the atmosphere at 400,000 feet.

"CC: We've just had one last time around the room and everybody says you're looking great.

"SC: Thank you."

Three long minutes passed as friction with the air raised the heat shield to a fiery glow that blacked out radio communication. Then:

"CC: Odyssey . . . standing by.

"SC: Okay . . .

"CC: Okay, we read you, Jack.

"SC: We got two drogues.

"Recovery ship: I have Astronaut Haise aboard and his condition is excellent . . . I have Astronaut Swigert on board. He reports He feels fine . . . I have Captain Lovell aboard. He reports he feels fine."

The charred command module had drifted down through broken clouds to a splashdown in moderate seas four miles from the USS *Iwo Jima* at 1:08 p.m., 142 hours 54 minutes 41 seconds after launch.

As the President of the United States said later: "The three astronauts did not reach the Moon, but they reached the hearts of millions of people in America and in the world."

Jim Lovell said: "We do not realize what we have on Earth until we leave it."

**The End of a Nightmare**—Flight directors and others at the Houston center applaud the successful splashdown of the Apollo 13 astronauts. In the background, Dr. Christopher C. Kraft, Jr. (then manned spacecraft center deputy director) lights a cigar for Dr. Robert R. Gilruth (then director of the center). Flight directors (l. to right in foreground) are: Gerald D. Griffin, Eugene F. Kranz and Glynn S. Lunney.

## Two NASA Employees Win Top Honors

The Arthur S. Flemming Award was presented to engineer Ivy F. Hooks and astronomer Dr. James B. Pollack at luncheon ceremonies held March 12, at the Washington D.C. Hyatt Regency Hotel. The highly esteemed award, named after the Chairman of the U.S. Commissions on Civil Rights and Aging, is given anually in recognition of outstanding and meritorious work for the federal government. The luncheon was, as usual, sponsored by the Downtown Jaycees of Washington, DC.

Ms. Hooks, 36, who heads the Johnson Space Center's aerodynamic systems analysis section, engineering analysis division, and is integration manager for Shuttle separation systems, has made significant contributions to the advancement of manned space flight. As an expert in the analysis of the aerodynamics of manned space vehicles, she was an important asset to the success of the Apollo program and she plays a vital part in the design and development of Space Shuttle systems.

Hooks has been with NASA since she was graduated from the university of Houston with a B.S. in mathematics in 1963. She began her career at the Johnson center as an aerospace technologist. After receiving an M.S. in mathematics from the same university in 1965, Hooks focussed her professional attention on various aspects of manned space flight from the beginning. She has won a number of important awards and is a member of five professional associations.

Pollack, 39, a research scientist at the Ames Research Center's space science division, has achieved outstanding results in the field of planetary sciences. He has made original and fundamental contributions to humanity's understanding of the solar system, particularly of its planets. These contributions include studies of the evolution of Jupiter, Saturn and their satellites, of the atmosphere and clouds of Venus, and of the surface of Mars. He has applied his knowledge and his research techniques to problems concerning the Earth by studying the long-term climatic effects of natural and man-caused atmospheric changes.

Pollock, who holds an A.B. from Princeton University, an M.A. from the University of California (Berkeley) in physics, and a Ph.D. from Harvard in astronomy, joined NASA in 1970 at the Ames center. He is the author of some 100 publications in major scientific journals and of 10 articles in encyclopedias. He is the winner of a number of other awards, a member of several professional societies and has been a visiting professor at the California Institute of Technology, Cornell University and New York State University at Stonybrook.

## Lushina Named to New Job

Louis N. Lushina recently became director of the information systems division, Office of Management Operations. Lushina will be responsible for managing agency-wide information systems efforts and ADP resources. His appointment was effective Feb. 20, 1978.

Lushina came to NASA in 1968 and since then has served as the deputy director of financial management, Office of the Comptroller. He has received the NASA Exceptional Service Medal.

Lushina is a native of Warren, Ohio. He received a B.S. degree in business administration from Ohio State University in 1950 and a M.S. degree from George Washington University. He also is a graduate of the Federal Executive Institute.

## Porpoises' Movements and Habits May Be Tracked by Satellite

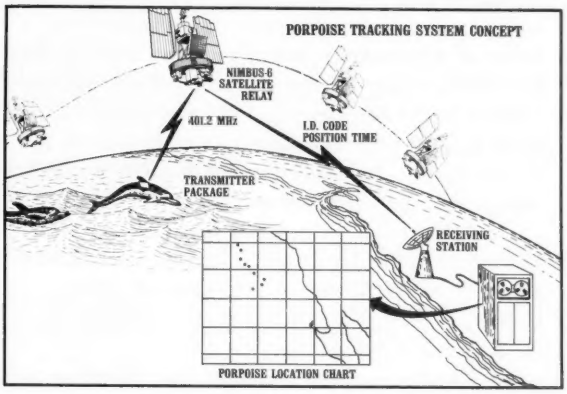
One of the tenant agencies at NASA's National Space and Technology Laboratories is engaged in a highly innovative experiment, whose eventual purpose is to try to determine patterns of migration, movement of various species, and distribution of porpoises in the Pacific Ocean. The organization involved is the National Marine Fisheries Service, a unit of NOAA (National Oceanic and Atmospheric Administration, Commerce Department).

Researchers at the NOAA fisheries laboratory at the Mississippi center constructed a large at-sea "corral" to be used as a confinement facility for

handling captured porpoises. The facility was shipped in early March to NOAA's Southwest Fisheries Center at La Jolla, Calif., where extensive marine mammals research projects are customarily carried out.

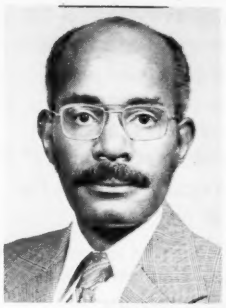
In another NOAA unit—also at the NASA Mississippi center—data buoy researchers are cooperating by developing a transmitter, later to be attached to porpoises for a year to track the mammals. (All such experiments and plans, incidentally, have been reviewed repeatedly with concerned conservation organizations and the U.S. government has given the go-ahead to the project, so long as its progress is carefully monitored every step of the way to be sure that no harm comes to the animals involved.)

If the concept appears feasible, transmitter packages will be affixed to porpoises, which will transmit data to the Nimbus-6 satellite for one year. It, in turn, will relay the material to a shore-based receiving station for analysis and evaluation of what is expected to be a large amount of information on the various sub-species of porpoise often found in the Pacific in association with tuna populations.




Many other cooperative projects with the fisheries service that are, or have been, conducted at the NSTL are heavily dependent on data collecting by NASA satellites. For example, in 1972-73, Landsat-1 was an important adjunct to a program in which the abundance and distribution of menhaden (an extremely important commercial fish species) were evaluated in Mississippi Sound; in 1973, the fisheries service used Skylab imagery to try to pinpoint and monitor oceanic gamefish populations. A Landsat-assisted program, concluded last year, demonstrated conclusively that distribution patterns of certain commercial fish could be inferred from space.

## New Director for Personnel Programs



Effective Feb. 27, Carl E. Grant became director of the personnel programs division, Office of Management Operations. As such, he is responsible for managing the agency's program of personnel administration.

Grant has been acting director, personnel programs division, since December 1977. Before that he served as NASA personnel director in the office of center operations. Grant came to NASA in 1976 from the Small Business Administration where he was personnel director. He also was associate director of personnel at the Smithsonian Institution and with the bureau of executive personnel at the U.S. Civil Service Commission.

A native of Detroit, Mich. Grant received a degree in economics from the University of Detroit and is a graduate of the Federal Executive Institute.

## Contractor News

**Advance Services, Inc.** of Atlanta, Ga., has been given a NASA contract to provide security guard services at the Goddard center. The cost-plus-award-fee contract covers a year and contains two one-year optional extensions, at an estimated cost of about $2.2 million. The contract calls for the provision of all necessary personnel, supplies and equipment to maintain physical security and control access to the center.

**Lockheed Electronics Co., Inc.,** has won a contract from the Johnson center for test stand operation, laboratory support services, and maintenance and operations services at the Johnson White Sands test facility. The contract, covering 12 months, is worth $16 million.

**Fairchild Space and Electronics Co.** of Germantown, Md., has been selected by NASA for negotiation of a fixed-price incentive contract to integrate, test and provide two multimission modular spacecraft for Landsat-D. The contractor's target cost is some $10.3 million for the basic requirements. Hughes Aircraft Co. of El Segundo, Calif., is a major subcontractor, responsible for development and testing of a propulsion module. The contract will be managed by the Goddard center.

**General Dynamics Corp. Convair Division** has won a $6.8 million contract for Atlas and Centaur program support activities. The Atlas portion of the contract amounts to $2.6 million and the Centaur portion to $4.2 million. The cost-plus-fixed fee contracts provide for spare parts, refurbishment, overhaul and maintenance of government owned hardware, storage and shipment of launch vehicles and logistics support. The Lewis center manages the Atlas/Centaur vehicle through all phases of manufacturing, testing and launch.

**Teledyne Brown Engineering** of Huntsville, Ala., has been selected by the Marshall center for negotiations leading to the award of a contract for payload missions integration for the sixth Space Shuttle orbital flight test, the first three Spacelab missions, and the sixth Space Shuttle orbital flight test. The company has proposed a total cost of about $6 million.

**Northrup Services, Inc.** of Houston has signed a cost-plus-award-fee contract with the Johnson center covering maintenance and operation of life sciences and engineering laboratories, and the lunar curatorial laboratory at the center. The $23 million contract runs from 1978 to May 1980.

**The Raytheon Service Co.** of Burlington, Mass., has been selected by the Goddard center for negotiation of a contract to operate its networks logistics depot, presently located near Baltimore. The contractor's estimated price of the cost-plus-award-fee contract is about $48 million, for a two-year period, with two options.

**Ford Aerospace and Communications Corp.** has signed a contract modification with the Johnson center covering hardware and software systems engineering, and maintenance and operations of the mission control center and other ground-based data systems at the Johnson center. The modification, valued at more than $1 million, brings the total value of the cost-plus-award-fee to some $52 million.

## Viking Scientists Award Student Grant

A total of $5,000 in student grants for the support of undergraduate research projects in planetology or astronomy, will be made this spring by the scientists of NASA's Viking project. The money accompanied the annual Newcomb Cleveland Award, which was presented Feb. 15 to 150 Viking scientists by the American Association for the Advancement of Science (AAAS). The Cleveland Award was made to all the authors of scientific papers that appeared in three special Viking issues of *Science* magazine in 1976 (Aug. 27, Oct. 1 and Dec. 17). This is the first year in which the award was made to a group of scientists.

The student grants will be given, in amounts ranging from $500 to $2,000, to fund a student's (or a student group's) ideas or to supplement student work in progress. Selections will be based on originality and feasibility, and all ideas will be treated as proprietary.

Proposals for grants must be received by April 15, 1978. Worthy projects will be selected by a representative committee of the Viking scientists. Students whose projects are chosen will be notified by May 1, so that work can be done this summer.

Proposals may involve research work in space missions now under way, in the field, or in laboratories, observatories, libraries, or any other location consistent with the goals of the proposed work.

## NASA European Representative Named

James R. Morrison has been appointed NASA's European representative in Paris, succeeding Walter P. Murphy who returns to a new NASA assignment in the United States in March.

For the past 3½ years, Morrison has been manager of the earth resources survey program in NASA's Office of Applications. Before that, he served 12 years in NASA's Office of International Affairs. Morrison enlisted in the Air Force in 1953 and entered the flight training program. As a pilot of both F-86 and F-100 aircraft, he was flight commander, operations officer and squadron commander.

He holds a B.S. in political science from the University of California and a M.S. in international affairs from the School of International Affairs, Columbia University. He has been employed by NASA since 1962.

As NASA European representative, Morrison will serve in a liaison capacity between NASA and European space agencies on matters of mutual interest. He will report to the Director of International Affairs at NASA headquarters.

## Patents for Inventions from NASA Research

*The Office of General Counsel, NASA Headquarters, announces that the following U.S. patents have been issued by the U.S. Patent Office to NASA for inventions resulting from NASA research. Inquiries concerning them should be directed to the attention of the NASA Patent Counsel of the indicated installation.*

| Inventor(s) and Employer(s) | Title & NASA Docket | Patent No. | Installation |
|---|---|---|---|
| Paul P. Zebus, Poley N. Packer } Rockwell International Corp., Downey, Calif. | Adjustable securing base | 4,066,039 | JSC |
| Louis N. Mogavero, Edwin G. Johnson, John M. Evans } NASA/Hq. | System and method for tracking a signal | 4,067,015 | HDQS |
| William E. Perry, NASA/JSC | Optical conversion method | 4,067,043 | JSC |
| Michael S. Shumate, NASA/JPL Pasadena, Calif. | Differential opto-acoustic absorption detector | 4,067,653 | NRLO |
| Leroy Honeycutt, Jr., Charles R. Manning, Jr. } N. Carolina State Univ., Raleigh, N.C. | Thermal shock and erosion resistant tantalum carbide ceramic material | 4,067,742 | LARC |
| Arthur P. Adamson, General Electric Co., Cincinnati, Ohio | Variable thrust nozzle for quiet turbofan engine and method of operating same | 4,068,469 | LERC |
| Donald F. Sargisson, Arthur P. Adamson } General Electric Co., Cincinnati, Ohio | Gas turbine engine with convertible accessories | 4,068,470 | LERC |
| Donald L. Alger, William Schwab, Edward R. Furman } NASA/LERC | Closed loop spray cooling apparatus | 4,068,495 | LERC |
| J. Dwight Johnston, Dr. Leendert Kersten } NASA/MSFC, Univ. of Nebraska, Lincoln, Neb. | Wrist joint assembly | 4,068,763 | MSFC |
| Anthony J. Miller, NASA/GSFC | Binary to binary coded decimal converter | 4,069,478 | GSFC |
| Kenneth R. Sidman, Arthur A. Massucco } Arthur D. Sidman, Inc., Cambridge, Mass. | Flame retardant spandex type polyurethanes | 4,069,212 | MSFC |
| Gerald V. Brown, NASA/LERC | Magnetic heat pumping | 4,069,028 | LERC |
| James Vine, Westinghouse Electric Corp., Pittsburg, Pa. | Magnifying image intensifier | 4,070,574 | GSFC |
| Ralph H. Brown, General Electric Co., Cincinnati, Ohio | Variable mixer propulsion cycle | 4,069,661 | LERC |
| Louis B. Holdeman, National Bureau of Standards, D.C. | Method of producing porous copper workpieces and product thereof | 4,070,207 | MSFC |

## New NASA Publications

**NASA Tech House, EP-149** is a 20-page booklet produced by the office of public affairs, which describes a functional, 138-square-meter (1,500-square-foot) house designed and built at NASA's Langley Research Center. It demonstrates, in a cooperative venture with other federal agencies, the new technologies available to home builders—technologies that can markedly enhance energy and water conservation, safety and security. The U.S. Government Printing Office sells the booklet for $1.10.

**Voyager, NF-87,** a 12-page pamphlet produced by the office of public affairs, describes the overall Voyager program involving a close examination of Jupiter and Saturn by two NASA spacecraft. They will fly by Jupiter in 1979. The Saturn approaches will occur in 1980 and 1981. The pamphlet is for sale by the U.S. Government Printing Office for 70 cents per copy.

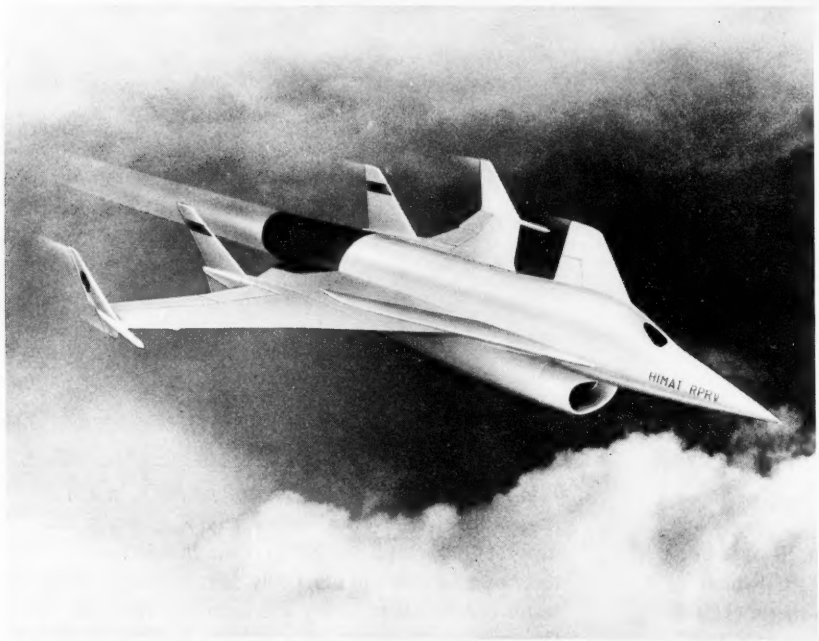
**Laser Wire Stripping, NASA SP-5107,** is a booklet in a series sponsored by the NASA Technology Utilization Office to help industry and institutions benefit from research and development in the aerospace field. Paperbound, 40 pages, for sale by the National Technical Information Service, Springfield, Va. 22161, for $4.50.

**Advances in Sterilization and Decontamination: A Survey, NASA SP-5105,** is a Technology Utilization survey on the sterilization of spacecraft to avoid contamination of other planets because of the enormous importance of the possible discovery of extraterrestrial life. The information is based on the experience with Viking, in which NASA designed, developed, and successfully flew two sterile landers to the Martian surface. Paperbound, 200 pages, for sale by the National Technical Information Service, Springfield, Va., 22161, for $9.00

**Astronautics and Aeronautics, 1974: Chronology on Science, Technology and Policy, NASA SP-4019,** is the NASA history office's annual compilation of excerpts from the media and other sources that document activities in aerospace and aeronautics. The publication is indexed and includes several appendices of the year's space launches and probes. Paperbound, 332 pages. On sale at Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, for $4.90.

**The Soviet-American Conference on Cosmochemistry of the Moon and Planets, NASA SP-370,** is an account of a conference held in Moscow June 4-8, 1974. Discussed were the differentiation of lunar and planetary matter; the thermal history of the Moon; lunar magnetism and gravity; the chronology of the Moon, planets and meteorites; the role of exogenic factors in the formation of the lunar surface; the cosmochemical hypotheses of the origin and evolution of the Moon and planets; and new data on the planets. Paperbound, 960 pages. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, for $18.00.

---

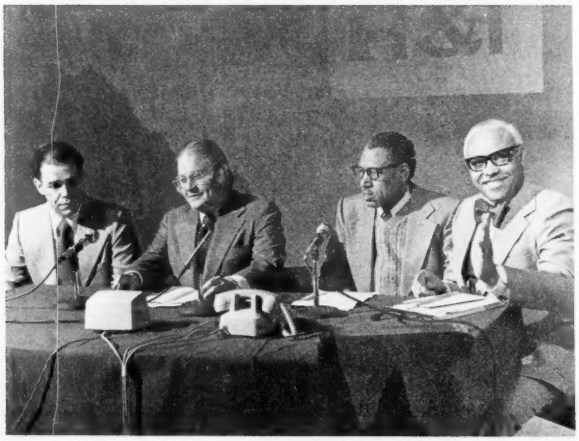



**Remotely Piloted Research Vehicle** —the HIMAT (for Highly Maneuverable Aircraft Technology) is a joint NASA-Air Force effort that uses scaled, unmanned, remotely controlled flight vehicles for low-cost flight research and experimentation. It uses extremely advanced technology concepts. The HIMAT will undergo many flight tests in the future, before the principles involved can be integrated into operating aircraft.

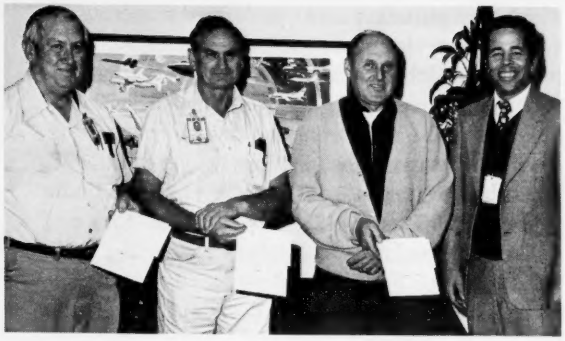
## Launches for 1978—Completed and Projected

| Name | Launch Date | Vehicle | Range | Mission Remarks |
|---|---|---|---|---|
| Intelsat IVA-(F3) | Jan. 6 | Atlas-Centaur | ETR | Improved communications satellite for Comsat. Reimbursable. |
| IUE-A | Jan. 26 | Delta | ETR | International Ultraviolet Explorer—cooperative with ESA. Designed to obtain high resolution data on stars and planets in the ultraviolet region of the spectrum. |
| FLTSATCOM-A | Feb. 9 | Atlas-Centaur | ETR | Navy fleet satellite communications. Reimbursable. |
| Landsat-C | March 5 | Delta | WTR | Third Earth resources technology satellite. |
| Intelsat IVA-F6 | March 31 | Atlas-Centaur | ETR | Improved communications satellite for Comsat. Reimbursablie. |
| Japan/BSE-A | April 7 | Delta | ETR | Broadcasting satellite experimental. Japanese communications satellite for conducting TV broadcast experiments. Reimbursable. |
| AEM-1 (HCMM) | April 27 | Scout | WTR | Heat capacity mapping mission to produce thermal maps for thermal inertial measurements, investigate feasibility of geothermal source location by remote sensing, and provide coverage of snow field for water runoff prediction. |
| OTS-B | April 27 | Delta | ETR | ESA orbital Test Satellite. |
| NOAA/ GOES-C | May 25 | Delta | ETR | Part of global network of geostationary environmental satellites to provide Earth imaging, monitor the space environment, and relay meterological data to users. Reimbursable. |
| Pioneer Venus-A | May 20 | Atlas-Centaur | ETR | Planetary mission to Venus. Orbiter will measure upper atmosphere and ionosphere, study interaction between solar wind and ionosphere and magnetic field, study atmospheric and surface characteristics, determine gravitational field harmonics. |
| Seasat-A | May 17 | Atlas-F | WTR | Sea satellite for global monitoring of ocean geoid, wave topography, surface wind speed and direction, ocean surface temperature, and ice field extent and dynamics. |
| Comstar-C | June | Atlas-Centaur | ETR | Third in a series of domestic communications satellites for Comsat. Reimbursable. |
| ESA/GEOS-B | June | Delta | ETR | ESA spacecraft to conduct scientific investigation of waves and particles in magnetosphere. Reimbursable. |
| UK-6 | July | Scout | WI | United Kingdom spacecraft to measure ultra-heavy cosmic ray particles and study low-energy cosmic X-rays and the fast secular behavior of X-ray sources. Reimbursable. |

| | | | | |
|---|---|---|---|---|
| ISEE-C | July | Delta | ETR | International Sun Earth Explorer. An extension of interplanetary studies with the spacecraft toward the Sun sufficiently outside the Earth's influence for comparison with results of ISEE-A and B missions and of space probes to outer planets. |
| TIROS-N | Aug. | Atlas Centaur | WTR | Polar orbiting operational spacecraft to provide and improve meteorological data for NOMSS and provide support to GARP. |
| Nimbus-G | Aug. | Delta | WTR | Develop and flight test advanced sensors and technology basic to conducting experiments in the pollution monitoring, oceanographic, and meteorological disciplines. |
| Pioneer Venus-B | Aug. | Atlas-Centaur | ETR | Multiprobe—will determine nature and composition of clouds, composition structure and general circulation pattern of the atmosphere of Venus from the surface to high altitudes, study interaction between planetary environment and interplanetary medium. |
| Japan Backup | Sept. | Delta | ETR | Backup spacecraft for Japan. |
| Navy-20 | Sept. | Scout | WTR | Navy navigation satellite. Reimbursable. (Call-up.) |
| NOAA-A | Sept. | Atlas-F | WTR | Advanced operational prototype spacecraft and sensors for a third generation series of operational meteorological satellites. Reimbursable. |
| NATO III-C | Oct. | Delta | ETR | Communications satellite, second in series. |
| HEAO-B | Oct. | Atlas-Centaur | ETR | Second high energy astronomical observatory to study highly energetic radiation from space. |
| Telesat-D | Nov. | Delta | ETR | Canadian domestic communications satellite. Reimbursable. |
| FLTSATCOM-B | Dec. | Atlas-Centaur | ETR | Navy fleet satellite communications. Reimbursable. |



**Experts Discuss Teaching by Satellite**—The opening session of the curriculum-sharing demonstration featured a panel discussion by (from left) Frederick D. Gregory, NASA Space Shuttle astronaut; Dr. John E. Duberg, associate director of the Langley center; Dr. L. C. Dowdy, Chancellor of N.C. & A&T; and Leo Williams, professor of electrical engineering.



**Presidential Recognition**—Three NASA employees at the Dryden Flight Research Center received letters of commendation from President Jimmy Carter for their suggestions, which resulted in savings of over $786,000 to the government. Jim Newman's (left) suggestion described how to build an advanced air measurement device on an F-15 aircraft, thereby saving about 600 man hours. Stanley Markey (second from left) and John McTigue (second from right) were commended for their research and development of the overload transportation route of the orbiter which made unnecessary the construction of a mate/demate device at the Rockwell facility in Palmdale, and saved the government about $780,000. The Presidential letters were presented by acting center director Ike Gillam (right).

**Congressional Visitor**—The Hon. Goodloe Byron (bottom of stairs) Sixth Congressional District and a member of the House Armed Services Committee visited the Dryden center recently and inspected the Space Shuttle *Enterprise.*

## Service for Stamp Collectors

The Marshall Space Flight Center's employee organization has announced the events for which it plans to offer service to stamp collectors during 1978.

For each announced event, stamped and addressed envelopes may be submitted to which a rubber stamp cachet will be affixed and the envelopes cancelled at the Marshall center on the day of the event.

The events are as follows:

Arrival of Space Shuttle orbiter at the Marshall center for a lengthy ground test series (March).

First static firing of the Shuttle's cluster of three main engines at NASA's National Space Technology Laboratories, Bay St. Louis, Miss. (March).

Beginning of first test phase, Shuttle orbiter and external tank (April).

Beginning of second test phase, Shuttle orbiter, external tank and solid rocket boosters full (September).

Beginning of third test phase, Shuttle orbiter, external tank and solid rocket boosterrs empty (October).

Departure of orbiter (December).

## Space Shuttle Contributions Recognized

When *Enterprise,* America's newest spacecraft put into the NASA Marshall Space Flight Center on March 13 for a series of ground vibration tests, it officially brought to an end the highly successful approach and landing test (ALT) project.

Donald K. Slayton, who headed up the more than 600-member NASA/industry and DOD team that worked on ALT, said "completion of ALT now allows us to begin orbital flight testing with a high level of confidence, both in the spacecraft and in the personnel who will conduct the orbital flight test (OFT) program." It was a NASA-wide effort, a program that used a wide variety of talents from the Johnson Space Center, the Kennedy Space Center and the Dryden Space Flight Center as well as the industry and the DOD, Slayton said.

Astronaut Slayton, since early March manager of OFT for the Space Shuttle program office at the Johnson center, said "*Enterprise* performed well and ALT demonstrated that the NASA/industry-DOD team can handle a difficult flight test job within tight schedule and budgetary limits." At an award ceremony at Houston, Slayton told his team leaders, "I wish to thank each member of the ALT team for his exceptional performance."

For his leadership in ALT, Slayton was presented the NASA Outstanding Leadership Medal while 15 other key NASA personnel, including astronaut crew and 747 crew members, were given NASA Exceptional Service Medals for their roles.

Dr. Christopher C. Kraft, JSC Director, presented the awards before a crowd of 40,000 plane-side after the 747 with Enterprise landed at the Ellington Air Force Base, north of the Johnson center on a refueling stop enroute from the Dryden center to Alabama. A crowd of 240,000 people turned out to see the Shuttle orbiter. Houston police called the result "the largest traffic jam in Houston's history."

The award to Slayton credited him for organization and molding "a diverse group of NASA, Department of Defense, and contractor personnel into a dynamic test team that successfully planned and carried out the ALT program. His outstanding leadership was a major factor in the success of the ALT flights."

A total of 13 flights were made in the ALT program beginning with the taxi tests of the mated 747/orbiter combination in February and concluding with the fifth and final "free flight" on Oct. 12, 1977. After the initial taxi tests, there were five unmanned "inert" captive flights, during which the 747 carried the orbiter *Enterprise,* with its systems inactive to assess the vehicle's combined structural integrity as well as determine its aerodynamic performance at various speeds and altitudes. The five captive unmanned flights were followed by three manned captive flights during which time astronaut crews performed numerous system and performance tests while the orbiter remained attached to the top of the 747 carrier.

The first "free flight," with astronauts Haise and Fullerton at the controls of the 75-ton orbiter *Enterprise,* was successfully flown on Aug 12, 1977. The orbiter was released from the 747 at an altitude of about 7,500 meters (24,000 feet), and Haise and Fullerton piloted the spacecraft to a successful landing at Edwards Air Force Base dry-lake runway five minutes and 21 seconds later. A second flight, with Astronauts Engle and Truly at the controls of *Enterprise* took place Sept. 13. This was a five-and-a-half-minute flight after which spacecraft commander Engle said the orbiter performed superbly. Pilot Truly said *Enterprise* was an excellent machine to handle.

Three more flights of the orbiter from its carrier aircraft followed, and the flight test program ended with the fifth and final flight on Oct. 12. With Haise and Fullerton at the controls, the orbiter made a landing on the hard Edwards runway.

A series of "ferry flights" followed. These tests, which were completed in mid-November, assessed the aerodynamic characteristics of the combined 747/orbiter vehicle in the "ferry mode." The "ferry mode" will be used during operational Shuttle flights where the orbiter is transported cross-country from its manufacturing site to launch sites and subsequent landing sites back to launch sites, either at the Kennedy center or the USAF launch site at Vandenberg, Calif.

**Texans Turn Out in Droves for Shuttle**—Part of the enormous crowd that gathered at Ellington Air Force Base to get their first look at the paired 747 and orbiter, which was refueling for the final leg of the Dryden-to-Marshall trip. Award ceremonies were conducted on the platform in front of the aircraft.

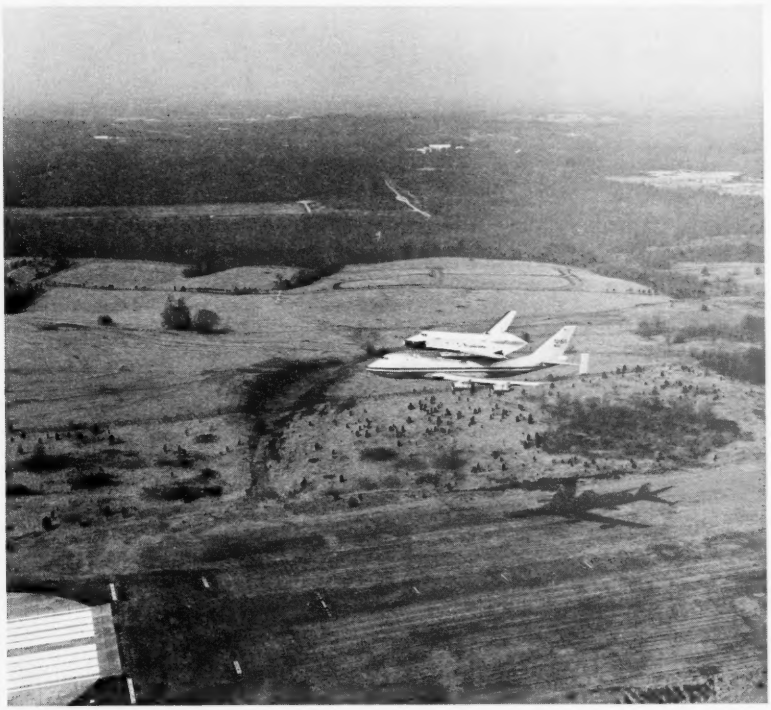
The ALT program officially ended with the delivery of *Enterprise* to Marshall center, where it will undergo a series of ground vibration tests preparatory to the initial orbital flight test now scheduled for the spring of 1979. The first orbital vehicle will be orbiter 102, now being assembled at the Rockwell International facility at Palmdale, Calif.

Nine JSC employees, five DFRC and one KSC employee received the Exceptional Service Medal at the ceremony in Houston.

Astronauts Haise, Fullerton, Engle and Truly received their awards for their roles as members of the ALT obiter crew. Other recipients at JSC were Thomas U. McElmurry, who was commended for the operational planning, organization, and day-to-day management of ALT; Carl B. Peterson whose award was for his management of the 747 carrier aircraft modification program; John W. Kiker's commendation was for his conception of the idea of using the 747 as the carrier of the orbiter; Louis E. Guidry, aircraft engineer, who was a key member of the 747 carrier aircraft during the entire ALT program; and Donald R. Puddy, flight director, who demonstrated exceptional ability in preparing and directing the ALT flight control team at JSC.

Those at DFRC who received the exceptional service medal included 747 crew members Fitzhugh L. Fulton, Jr., Thomas C. McMurtry; flight engineer Victor W. Horton; and William H. Andrews, the Shuttle carrier aircraft test team manager. John G. McTigue of Dryden was awarded the Exceptional Service Medal for his outstanding leadership in planning and directing the overall center support of the ALT Program.

Paul C. Donnelly of the Kennedy center, who managed the ground operations for ALT, was commended for his outstanding leadership the entire ground operations engineering test team.



**Alabamians Turn Out, Too**—After the warm welcome in Texas, the 747 and *Enterprise* had a smooth trip to their berth—for several months—at the Marshall center. When the craft landed on the Huntsville runway, thousands of people were waiting to greet the remarkable pair.

# Another Dividend from Air and Space

Research and development in aeronautics and space have provided numerous benefits for all Americans—and at a tiny percentage of the tax dollar. Here is an example:

## The Long-lasting, Durable Electronic Pacemaker

Five years ago, on Feb. 10, 1973, at the Johns Hopkins Hospital, Mrs. Helen Chambers became the first recipient of a permanent, rechargeable cardiac pacemaker. Dr. Kenneth B. Lewis, cardiologist, and Mr. Robert E. Fischell, physicist, both from the Johns Hopkins University, were key figures in the development of this long-lasting device.

At the time the device was first implanted in human patients, conventional pacemakers required surgical reimplantation on an average of every two years because of worn-out batteries. Using the best developments of NASA's space technology, including a satellite type of rechargeable cell, Johns Hopkins scientists developed a pacemaker that contained no electrical components hampered by a limited life. Now, after five years of continuous operation—which makes it one of the longest lived pacemakers ever implanted—Mrs. Chambers' rechargeable pacemaker shows no indication of wearing out. The 82-year old Mrs. Chambers recharges her pacemaker once each week, as do most people who rely on the device. She shares the view of other patients who look forward to the recharging process because, she says, "It gives me something important to do and it tells me that my pacemaker is working properly." The pacemaker battery is recharged by means of an electric coil in a special "vest." Ordinary house current is used. The recharging period is about an hour.

Approximately 5,000 of the rechargeable pacemakers, manufactured by Pacesetter systems, Inc. of Sylmar, Calif. have been implanted to date.

**Charging Right Along**—Flanked by cardiologist Dr. Kenneth B. Lewis (left) and physicist Robert E. Fischell, developers of the Johns Hopkins rechargeable pacemaker, Mrs. Helen Chambers performs the weekly ritual of recharging her five-year-old pacemaker. The pacemaker was developed as part of a collaborative bio-medical engineering program between the Johns Hopkins University Applied Physics Laboratory and the Johns Hopkins Medical Institutions.

NASA
National Aeronautics and Space Administration